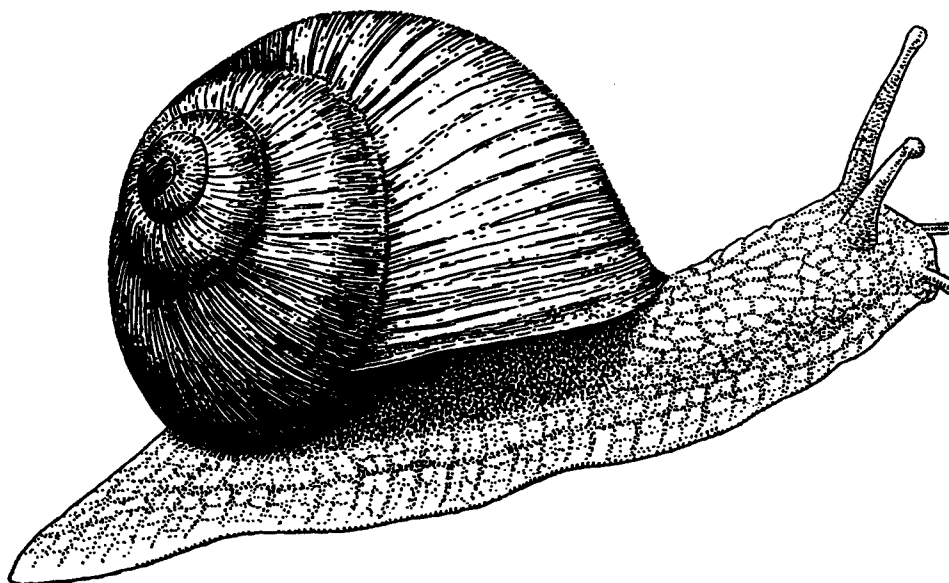
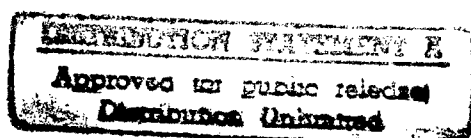


Edible Land Snails in the United States



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UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
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By

Lola T. Dees



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Cover photo.--Burgundy snail (Helix pomatia Linnaeus).

(Courtesy of Scientific American Magazine.)

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Lola T. Dees

Bureau of Commercial Fisheries
U.S. Fish and Wildlife Service

INTRODUCTION

Edible land snails brought into the United States have not been a blessing. Certain species are numerous in limited areas, and their damage to cultivated flowers and vegetables has caused people to make considerable effort to control and eradicate them. The effects of these gregarious immigrants seldom go unnoticed; on the other hand, native snails are seldom so numerous and the damage they do to plants is not so readily apparent. The flesh of snails, relished in many European countries, appeals to few people in this country.

REGULATIONS

Foreign edible land snails have been such a nuisance that the Congress of the United States has included them in legislation governing the importation of plant pests and their interstate movement.

Under this legislation, USDA (U.S. Department of Agriculture) will not approve the importation or interstate movement of edible snails for breeding or raising purposes. USDA issues permits on a limited basis only for importation of certain species of edible snails through the ports of Boston and New York for human consumption in the metropolitan areas of those cities. Movement of such snails into rural areas is not permitted. Anyone considering snail importations should consult with the U.S. Department of Agriculture, Plant Quarantine Division, Federal Center Building, Hyattsville, Md. 20782.

In addition to Federal regulations, some States have laws governing the movement of plant pests, including edible snails, into and within those States. Because the States vary considerably in their attitude toward snails as pests, their agricultural officials should be

consulted before any steps are taken to operate an edible snail farm, even though the species may be established in the State.

The U.S. Department of the Interior may also regulate the importation and interstate shipment of snails that are known to be injurious or potentially injurious to the wildlife or wildlife resources of the United States.

Anyone who knowingly violates the Federal laws and regulations affecting the movement of snails is subject to a fine or imprisonment, or both.

CLASSIFICATION

Edible land snails belong to the phylum Mollusca, the class Gastropoda (meaning stomach-footed), the order Pulmonata (lunglike organs), and the families Achatinidae (agatelike) and Helicidae (spiral form). The most important genera for food purposes are Achatina of the Achatinidae family and Helix, Cepaea, Otala, and Theba of the Helicidae family.

DESCRIPTION

The snail consists of the head, foot, and shell (with the visceral mass). The fleshy head bears two pairs of tentacles that can be retracted. Each tentacle of the longer pair has a tiny eye at the end. The eyes distinguish only light and darkness. The two shorter tentacles are knobbed at the ends and are probably organs of smell or touch. The mouth is in the center of the head, below the shorter pair of tentacles. It opens directly into a muscular cavity equipped with a horny jaw and a radula, a flexible filelike rasping organ with numerous rows of teeth for shredding food.

Behind the head is the broad, flat, retractile foot, which is a muscular organ used for

adhering to plants, crawling, and digging in the soil. A granular, tough skin, moistened by many slime glands, covers the dorsal (upper) part of the foot. The posterior end of the foot is usually pointed.

On the upper side of the body is a shell into which the snail can withdraw when danger threatens. Usually banded and generally wider than high, the shell may have three to six whorls, which normally turn to the right. A shell whose whorls turn to the left is rare. The lip (edge of the aperture--the opening or mouth of the shell) may be straight or variously curved; sometimes it is reflected (turned back). The surface of the shell may be ridged

gland, kidney, liver (digestive organ), and intestine (fig. 1). These vital organs are partially covered by the mantle, a tissue that lines the shell. The mantle is thin, except near the aperture of the shell; here it is thicker and secretes calcium carbonate that adds new shell around the aperture. Under the edge of the mantle, on the right side, is the breathing pore. Immediately behind this pore is the anus (the posterior opening of the alimentary canal).

Snails replace some of their parts. New teeth form on the radula as the old ones wear away. If a shell becomes damaged, the mantle quickly repairs it. A lost eye or a tentacle or a part of the foot is replaced.

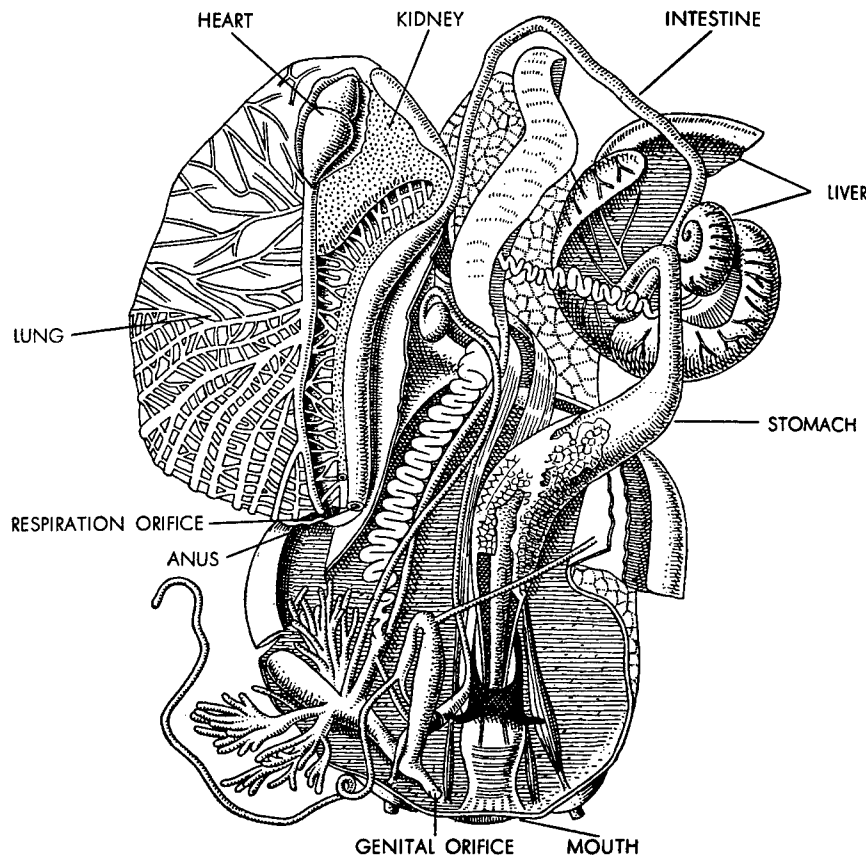


Figure 1.--Anatomy of *Helix pomatia* Linnaeus. (Courtesy of Scientific American Magazine.)

or granulated or plain with spiral bands, usually five or fewer.

The snail lacks a permanent calcareous operculum (door), which closes the aperture when the snail has withdrawn into the shell; however, it can make an operculum from gritty lime. To open the operculum, the snail rasps it away with the radula.

The visceral mass, the softest parts of the snail, is always confined within the upper whorls of the shell. It includes the tiny heart, stomach, the simple saclike lung, genital

Snails may live about 5 years or more. Well-marked lines on the shells generally indicate arrested growth, which coincides with dry or cold periods of the year.

REPRODUCTION AND THE YOUNG

This account of reproduction and the young pertains to a common European edible snail, *Helix pomatia*. The other snails listed in this paper have somewhat similar habits.

A snail is a hermaphrodite (producing both sperm cells and eggs); however, it does not fertilize itself. Mating occurs in early spring, occasionally again in July, sometimes later, depending on weather conditions.

The eggs are laid a few days after mating, usually in clumps of 50 or more. Each egg is about the size of a small pea, spherical, and gleaming white. The snail deposits the eggs in a cluster in a small hole dug in loose soil. Then mixing the sticky slime with the soil, the snail covers the hole, which may be an inch or so deep. Egg laying may take about 2 days. The snails do not tend their eggs or young.

Depending on the temperature, fertilized eggs hatch in 25 to 40 days. Cold weather delays hatching; warm weather accelerates it. Because a larval stage is absent, the newly hatched young snails look very much like adults. Whorls, secreted by the aperture edge of the shell, are added until the shell reaches its maximum size. Growth in many species stops when the lip of the shell thickens.

FOOD AND FEEDING

The food of snails varies. Adults eat tender flower and vegetable plants, decaying vegetable debris, and some fruits. Feeding occurs only at night or on dark days when light rain is falling or the ground is wet with dew. The snail locates food with its shorter pair of tentacles. Using the many small, hard teeth of the radula, the snail shreds the food and swallows it.

HABITAT

Snails occupy a great variety of habitats, preferring those which abundantly provide food, lime, moisture, and shelter. They are found near the sea or by bodies of fresh water, in woods, fields, gardens, basements, and walls, and in open plains and mountain sides. They are more frequently found on calcareous soils than on other soils; rarely are they found on acid soils.

LOCOMOTION

Snails move over the ground by drawing in the foot and pushing it forward in a series of waves. The constant and unvarying gait is slow--about 2 1/2 inches a minute for a large *Helix*. The slow locomotion leads to the expression "snail's pace."

With slime discharged from slime ducts under the front end of the foot, snails make silvery trails to protect the soft foot from injury.

BEHAVIOR

With the first frosts, snails prepare to hibernate. Some snails bury themselves in the ground while others take cover under boards, logs, and stones. A burrowing snail uses the foot to dig a hole in the soil larger than the shell. Each snail lines its hole with dead leaves and slime and buries itself in the hole. A hibernating snail builds an operculum over the aperture of the shell. Through the winter, snails remain in a torpid state, drawing on their reserves of fat and glycogen at a much reduced rate. In spring, they rasp open the operculum, emerge from the hole, and resume normal activities.

If the weather becomes too hot or dry, snails again resume a torpid state, called estivation. Hiding in crevices or underground or attaching to fence posts, tree trunks, and other objects, they seal the aperture of the shell and exist thus until the weather improves.

ENEMIES AND PROTECTION AGAINST THEM

Among the many natural enemies of the snail, the birds and small mammals are most important.

Snails, however, have ways to protect themselves from enemies. One method is to exude slime, which may discourage some foes. The nocturnal habits of snails may further protect them from those enemies not active during the night. Snails are also aided by their drab color, small size, and slow movement, which make them rather inconspicuous. Their ability to withdraw into the shell may also protect them.

CONTROL

Poisoning provides one method for controlling snails. Metaldehyde and calcium arsenate are effective (U.S. Department of Agriculture, 1959). Under dry conditions metaldehyde alone will kill snails, but under moist conditions the poison must be supplemented with calcium arsenate for satisfactory results. The bait containing these poisons comes in granular and pellet forms. Granules may be broadcast at the rate of 1 pound per 1,000 square feet, or about 1 teaspoon may be placed in piles every few feet. Pellets, preferable to granules for large-scale operations, may be broadcast at the rate of 5 to 10 pounds per acre or placed every few feet near plants. Dusts containing 10 percent metaldehyde may be applied at the rate of 1 pound per 1,000 square feet on ornamental crops in greenhouses. Emulsion concentrates containing metaldehyde must be diluted with water for spraying on ornamental plants and the surrounding soil. These dusts and sprays should not be used near vegetable plants.

Labels on the containers tell how to handle and use these poisons. Extreme caution should be used.

Other control measures are more commonplace. Materials that may contain snail eggs or young snails should not be brought into the greenhouse, basement, or other places where snails may live. Their hiding places, such as piles of boards, bricks, and stones and dense, low-growing vegetation, should be eliminated. Spaces beneath porches should be kept dry, and chinks in basement walls sealed. Hand-picking snails at night also helps eliminate them.

SPECIES

Nine species of land snails, described below, are known to be edible in their native countries. These snails were introduced into this country for food.

Achatina fulica Bowdich, Giant African Snail

The giant African snail (fig. 2), family Achatinidae, has a maximum body length of nearly 9 inches, a shell as large as a man's fist, and a large reproductive capacity (up to 600 offspring a year).

During the 19th century this voracious consumer of flowers, fruits, and green vegetables was transplanted from its African home and spread eastward across Asia, where it was

species, introduced this snail into the Pacific islands just before and during World War II. In 1936, it was introduced as a food source into Hawaii, the only place in the United States where it has become established. Taxpayers in Hawaii have spent some \$200,000 in an effort to control this agricultural pest (Burch, 1962). Perhaps their efforts will be more successful when more is known of its biology and ecology. Army equipment returned from war areas in 1948 brought this snail to California, but intensive eradication efforts prevented its establishment there.

The giant African snail, however, has infested north Miami, Fla. (The Washington, D.C., Evening Star, 1969). A young boy returning from a trip to Hawaii in 1963 brought three snails as a present to his grandmother. Three years later the Florida Department of Agriculture estimated that a 13-square-block area had up to 20,000 of the large, brownish snails. The snails are in a populated area and, therefore, cannot be poisoned from a plane. The Florida Department of Agriculture is trying to eradicate the snails by hand picking and poisoning. Pellets containing metaldehyde and arsenic were placed on the lawns. The first application killed large numbers of active snails but was ineffective on the ones estivating.

Cepaea hortensis (Müller), Garden Snail

The garden snail is widely distributed in central and northern Europe, Iceland, and Newfoundland. It was introduced during early



Figure 2.--Achatina fulica Bowdich. Courtesy of The University of Chicago Press.

often eaten by the natives. The East and West Africans, Chinese, and Formosan aborigines readily eat this snail (Mead, 1961).

In the 20th century, the snail was introduced into new areas. Japanese, who also eat this

Colonial days into Maine, Massachusetts, and New Hampshire but has not become established in those States.

The yellow shell has a white lip and usually one to five continuous reddish-brown bands

(fig. 3). Sometimes the bands are absent. An adult shell, with about five whorls, is about 1/2 to 1 inch wide and 1/2 inch high.

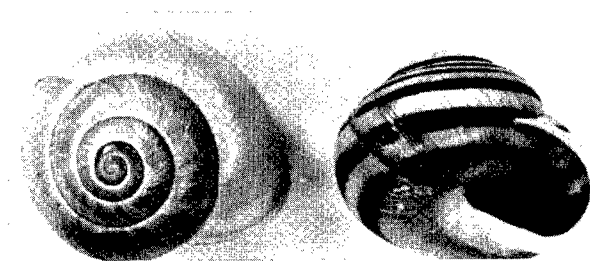


Figure 3.--*Cepaea hortensis* (Müller).

Cepaea nemoralis (Linnaeus), Wood Snail

The wood snail is distributed in central and western Europe and was introduced from there into Ontario, Canada. It is now found in Massachusetts, New York, New Jersey, Virginia, Tennessee, Pennsylvania, Wisconsin, Colorado, and California. This snail has not yet proved to be a destructive pest in this country.

The yellow, olive or red shell usually has one to five reddish-brown bands (fig. 4). In adults, the lip, dark brown to almost black, is turned back. The aperture is oval-shaped, like a half moon. An adult shell, with about five rounded whorls, is about 1 inch wide and about 1/2 inch high.

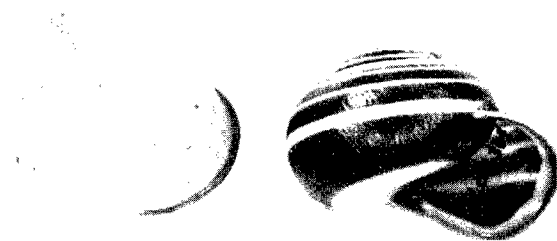


Figure 4.--*Cepaea nemoralis* (Linnaeus).

Helix aperta Born, Green or Burrowing Snail

The green snail occurs in France, Italy, the Mediterranean countries, California (where it was reported in April 1941), and Louisiana. In these States it does considerable damage to flower and vegetable gardens.

Efforts to eradicate the green snail in California have been discontinued, except for some local control. Now occurring only along the Mexican border just south of San Diego County, this snail has not spread and seems to be only a marginal agricultural pest. It is difficult to eradicate because it appears above ground only during the rainy winter season, and during dry weather it usually burrows into the soil as deep as 6 inches (Gammon, 1943). Most of these snails, however, are found in the first

3 inches of soil. The unusually dry winters of 1948-49 hampered its development, and its spread was held to a minimum (California Department of Agriculture, 1949). The snail digs a hole in the soil, builds a very thick saucer-shaped convex operculum, and estives throughout the summer, emerging only when the rains soften the soil. The few snails that do not burrow cling to vegetation, particularly in pasture areas.

Because its seasonal activity in California is limited, this snail may have only one batch of eggs per year. This presumption, however, may be incorrect because this species apparently becomes exceedingly abundant at times. A survey in California in October 1941 showed that the average number of eggs per snail nest was 75; the minimum, 36; and the maximum, 129 (Gammon, 1943).

The greenish brown shell is thin and rather glossy (fig. 5). Irregular striae (raised or impressed lines) finely sculpture the surface. The shell has no color bands and is imperforate (lacks a minute opening at the base). The aperture, more than two-thirds the height of the shell, is oval-shaped, like a half moon, and the lip is not turned back. Adult shells, with three to four rapidly widening whorls, are 1 inch wide and 1 1/2 inches high.

The color of the foot varies with the season, being light in late spring and very dark in the fall.

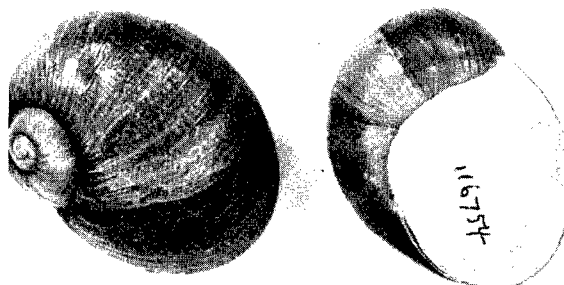


Figure 5.--*Helix aperta* Born.

Helix aspersa Müller, European Brown Snail, European Spotted Snail, Petit-Gris

The brown snail, the most widely eaten of all European snails, has been introduced into nearly every country that Europeans have settled. It is distributed in Britain, western Europe, and countries bordering on the Mediterranean and Black Seas. It was brought into the Atlantic islands, South Africa, Australia, New Zealand, Tasmania, Haiti, Canada, Mexico, Chile, and Argentina. In the United States it was introduced into Charleston, S.C. (before 1850); New Orleans, La. (from Spain, before 1850); Woods Hole, Mass. (from Ireland in 1883); Washington; Oregon; California; Portland, Maine (introduced in 1838 and last seen

there in 1936); Arizona; Utah; Florida (1963); and Dallas, Tex. So far as known this species no longer exists in Massachusetts and Maine; severe weather may have caused its disappearance. This snail does considerable damage to flower and vegetable gardens and orange groves.

The State of California Department of Agriculture is not trying to eradicate this snail because the cost would be prohibitive. It was introduced early (about 1850) and spread rapidly throughout most of the cultivated areas of the State before the California Department of Agriculture became "snail conscious."

The yellow or horn-colored shell is large, spherical, rather thin, and often lacks a minute opening at the base (fig. 6). Fine wrinkles sculpture the shell. Moderately glossy, it has chestnut-brown spiral bands that yellow flecks or streaks interrupt. The aperture is shaped like a half moon, and the white lip is turned back. Adult shells, with four to five whorls (the lowest whorl very large), are 1 1/2 inches wide and 1 1/2 inches high.

The foot of this snail is light to dark gray and about 2 inches long when fully extended.

This snail may lay eggs as often as once a month and can lay about 400 a year (Gammon, 1943). The frequency of laying depends almost entirely on the weather. The snails are not very active at temperatures much below 40° F. and usually remain burrowed during periods of low temperatures.

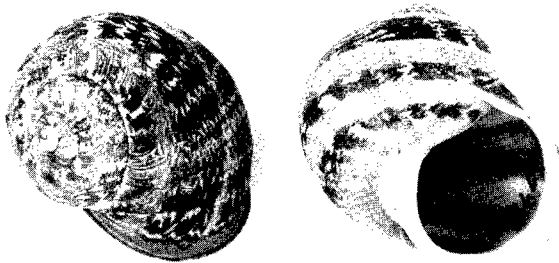


Figure 6.--*Helix aspersa* Müller.

Helix pomatia Linnaeus, Burgundy or Roman Snail

The Burgundy snail (drawing on cover) is distributed in central Europe, from southeastern Union of Socialist Soviet Republics to eastern France; from Denmark and southern Sweden in the north to the Balkan Peninsula in the south. It was introduced into North Africa, Argentina, Uruguay, and into the United States at New Orleans, La., and (from central Europe) at Jackson, Mich. It has spread very widely over southern Jackson, invaded the Grand River Valley, and was discovered in Kalamazoo, Mich. It has also been found in Florida. This snail damages gardens.

The light tan shell has rather wide, un-interrupted spiral cinnamon-brown bands (fig. 7). Fine spiral striae (impressed or raised lines) sculpture the shell. The shell may be perforate (having a minute opening at the base) to narrowly umbilicate (having a rather wide opening at the base). Sometimes it is imperforate (lacking a minute opening at the base). The thin lip is not turned back but sometimes is slightly expanded. Adult shells, with four to five whorls, are 1 3/4 inches wide and 1 1/2 inches high.

This snail may not reach its maximum size of 1 1/2 to 2 1/4 inches high until the second summer. The natural life span is about 6 to 8 years.

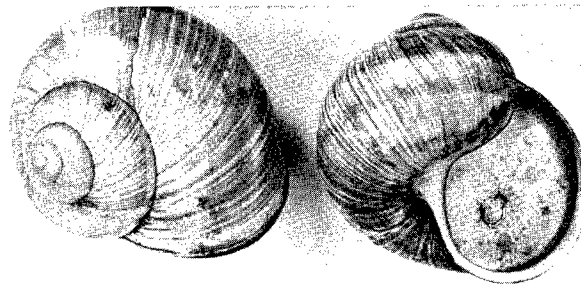


Figure 7.--*Helix pomatia* Linnaeus

Otala lactea (Müller), Milk Snail, Spanish Snail

The milk snail is distributed in southern Spain, North Africa, and South America. In the United States it was locally introduced into California, Texas, Mississippi, Florida, Georgia, and on Sullivan's Island, near Charleston, S.C. The milk snail has not developed into an important economic pest of agriculture. Except for some local control, California has discontinued trying to eradicate this snail. It has caused no problems in the other States.

The snail has a flattened white shell without a minute opening at the base (fig. 8). Fine, impressed spiral lines, more or less continuous, sculpture the shell. White flecks the reddish-brown spiral bands of the shell. The widely turned back lip in adults and the half moon-shaped aperture are dark brown. Adult shells, with about five well-rounded whorls, are 1 to 1 1/2 inches wide and 1 inch high.

These snails estivate high up on trees, buildings, poles, and other objects. Because they form a double operculum over the aperture, they apparently are better equipped than some of the other species to withstand extreme heat and cold.

In counts made in the winter of 1940 in California the number of eggs laid ranged from 40 to 100, averaging 66 per nest (Gammon, 1943). This species may lay more than one batch of eggs per year; for example, during the fairly warm weather of December and January 1940-41 the snails apparently laid eggs twice in less than a month.

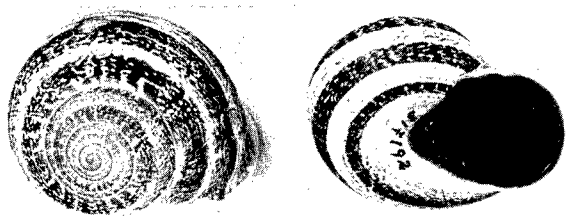


Figure 8.--*Otala lactea* (Müller).

Otala vermiculata (Müller)

This species is found in the Mediterranean countries. In the United States it was locally introduced into New Orleans, La. It was first seen at Jackson Square in New Orleans in 1918 but so far as known has not been collected there since. Its present status is not clear. [The snail does not have a common name.]

Interrupted, fine, spiral wrinkles sculpture the shell (fig. 9). Spiral color bands are absent from some individuals. The aperture and lip are white. Adult shells, with about five whorls, are about 1 1/2 inches wide and 1 inch high.



Figure 9.--*Otala vermiculata* (Müller).

Theba pisana (Müller), White Snail

A native of Sicily, the white snail is distributed in Ireland, southwestern England, Switzerland, western France, and the Mediterranean countries. It was introduced into the Atlantic islands, South Africa, Australia, and California, where it became well established. It is a very injurious garden pest. Though difficult to control because of its habits of estivation, it has been completely eliminated in California by flaming, poison baiting, and handpicking. It is not now known to occur anywhere in the United States.

The ivory-colored shell has a minute opening at the base (fig. 10). Brown lines, some of which are generally broken into dots and



Figure 10.--*Theba pisana* (Müller).

dashes, usually band the shell; however, single banded or pure ivory-colored shells are common. The aperture is shaped like a half moon. The lip is sharp, often ringed inside with a callus or thickening. Adult shells, with four to five well-rounded whorls, are 3/4 inch wide and 1/2 inch high. Many fine spiral striae (raised or impressed lines) sculpture the whorls.

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